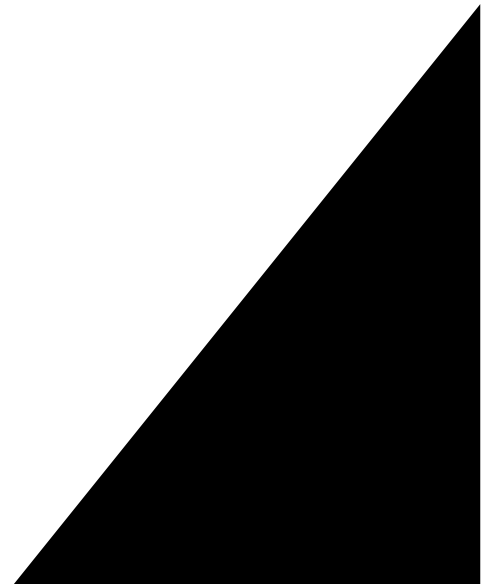




# User Manual

## CSR-DMT

*channel selective digital TETRA repeater*



# CSR-DMT

*channel selective digital TETRA  
repeater*



Rev 3-NM, Issued Nov. 2017

## TABLE OF CONTENTS

TABLE OF CONTENTS .....	3
CONTACT INFORMATION .....	4
1.0 GENERAL INFORMATION .....	4
1.1 Abbreviations .....	4
1.2 Warnings.....	5
1.3 Purpose .....	5
2.0 HARDWARE DESCRIPTION.....	6
2.1 Block diagram.....	6
2.2 Filters characteristics .....	6
2.4 Hardware AGC .....	9
2.5 Connectors, indicators, buttons .....	9
3.0 INSTALLATION.....	11
3.1 Mechanical installation.....	11
3.2 Electrical installation .....	12
3.4 Driver installation .....	12
4.0 CONTROL SOFTWARE .....	12
4.1 System requirements.....	12
4.2 Overview.....	12
4.3 Establishing a connection .....	12
4.4 Configuration interface.....	13
4.7 Firmware upgrade.....	14
5.0 APPENDIX.....	15
5.1 Technical specifications .....	15
5.2 CSR-DMT view .....	16
COPYRIGHT .....	16

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## 1.0 GENERAL INFORMATION

### 1.1 Abbreviations

ADC	Analog to Digital Converter
AGC	Automatic Gain Control
BTS	Base Transceiver Station
DAC	Digital to Analog Converter
DL	Downlink
ESD	Electrostatic Discharge
ETSI	European Telecommunication Standards Institute
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GUI	Graphical User Interface
IF	Intermediate Frequency
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LO	Local Oscillator
LTE	Long Term Evolution Mobile System
MCU	Main Controller Unit
OIP3	Output Intercept Point of third order
OutP1dB	Output Compression Point at 1dB
PA	Power Amplifier
PM	Power Meter
PSU	Power Supply Unit
Rev	Revision
RF	Radio Frequency
RSSI	Receive Signal Strength Indicator
RTC	Real Time Clock
SMS	Short Message Service
TETRA	Terrestrial Trunked Radio
UL	Uplink
UMTS	Universal Mobile Telecommunication System
USB	Universal Serial Bus
VCO	Voltage Controlled Oscillator
VSWR	Voltage Standing Wave Ratio
WCDMA	Wide-band Code Division Multiple Access

## 1.2 Warnings

Only qualified personnel can work with this unit.

Before using read all given specifications and manuals. Using the unit follow the recommendations and rules given in the related documents.

Keep operating manual within easy reach and make them available to all users.

It's the responsibility of the network provider to implement preventing measures to avoid health hazards that may be associated with radiation from the single or multiple antennas connected to the unit.

Installing and using the unit follow all obligatory regional regulations.

Use this unit only for the purpose specified by the manufacturer.

ESD precautions must be observed.

Make sure the unit settings are in accordance with the intended use and regulatory requirements.

## 1.3 Purpose

The full band repeater CSR-DMT is a bi-directional digitally controlled amplifier that offers an increase of signal strength in small and medium-sized rooms.

Generally TETRA repeaters are used in emergency services and government systems to provide signal coverage for areas with poor or no signal (e.g. blind spot). Procom A/S came across the insufficient coverage within buildings, airports, tunnels, etc. The digital repeater CSR-DMT series can solve these problems by amplifying the available signal from an outdoor antenna into weak coverage areas via an antenna or indoor delivery network with multiple antennas.

CSR-DMT is based on a digital filtering approach thanks to that the CSR-DMT is very flexible in continuously changing conditions of mobile communication systems. The digital filter can be reconfigured in a custom desired way:

- **Full band (5 MHz) is default configuration (factory settings)**
- Additionally it is possible to adjust bandwidth and center frequency of band-segment
- Possible number of band-segments is 1-4
- adjustable gain of individual band-segment

Built-in Automatic Gain Control circuit prevents the occurrence of undesired oscillations, signal compression and distortion conditions.

## 2.0 HARDWARE DESCRIPTION

### 2.1 Block diagram

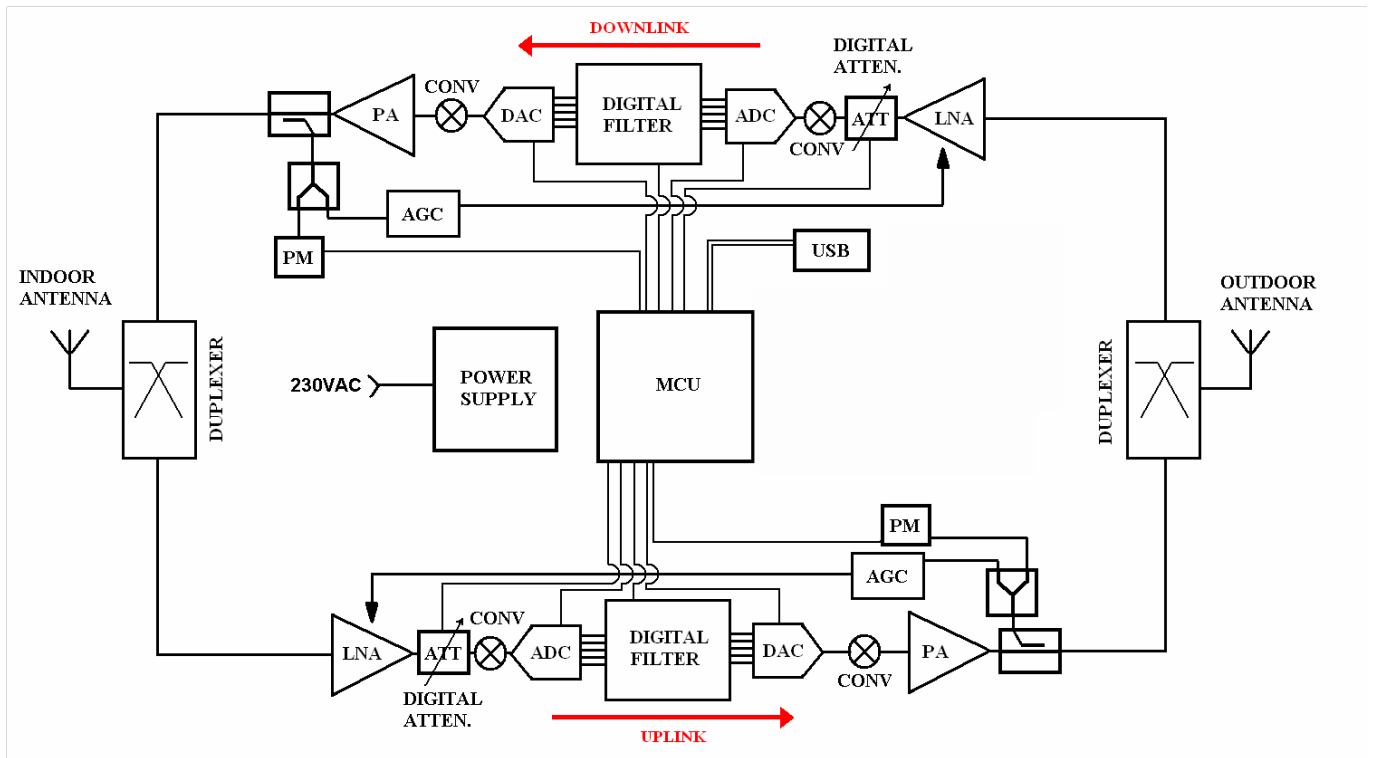


Figure 1. CSR-DMT block diagram

Presence of various nodes can be different for different ordering options of CSR-DMT.

### 2.2 Filters characteristics

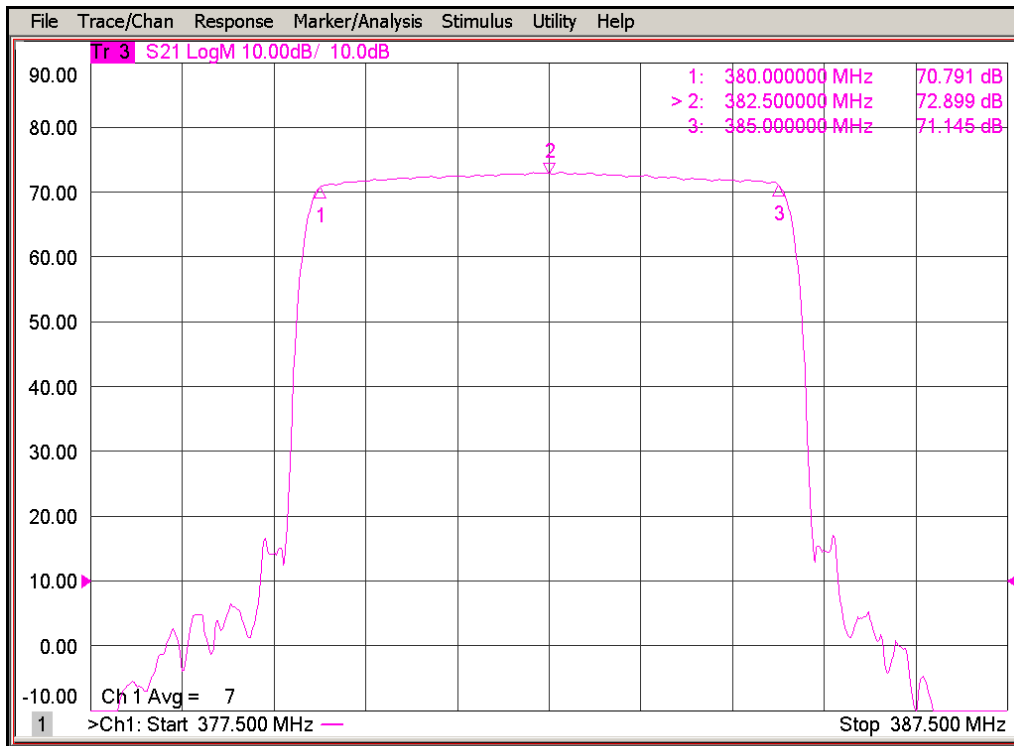
In this section digital filter characteristics are described. Digital filter node is purely software based, thanks to that it is possible to reconfigure selective filters in a desired way without any change to the hardware. In the next picture some examples of possible filter configuration are given.

Each direction can have up to four band-segments. Each segment bandwidth can be selected from a range of 25 kHz up to 5 MHz. Bandwidth adjustment steps for bands 25 kHz up to 1MHz is 25 kHz. Bandwidth adjustment steps for bands 1.1 MHz up to 5 MHz is 100 kHz.

Filters have selectivity properties according to ETSI TETRA standards. All filters can be divided into two different groups. Filters from first group have better selectivity.

Table 1. Filter groups

Group number	Passband
1	25 kHz - 1 MHz (step 25 kHz)
2	1.1 MHz - 5 MHz (step 100 kHz)



If needed the repeater pass band can be constructed from two or more segments. For instance using such a composite method with filters from group 1 (see table above) it is possible to make wideband filter with best selectivity properties.

Applying composite method it must be taken into account the real transition band in amplitude-frequency response of the filter. Putting filters pass-bands in “edge to edge” style there will exist a high probability to get distortions in amplitude and phase of composite filter. To smooth such effects it is recommended to put particular segments with small offset 50 - 400 kHz. For best modulation performance do not use composite bands.

Below different examples of bandwidth filters are shown. All filters are demonstrated in base-band with half-bandwidth. Due to digital nature filter shapes are stable and symmetrical over entire frequency range.

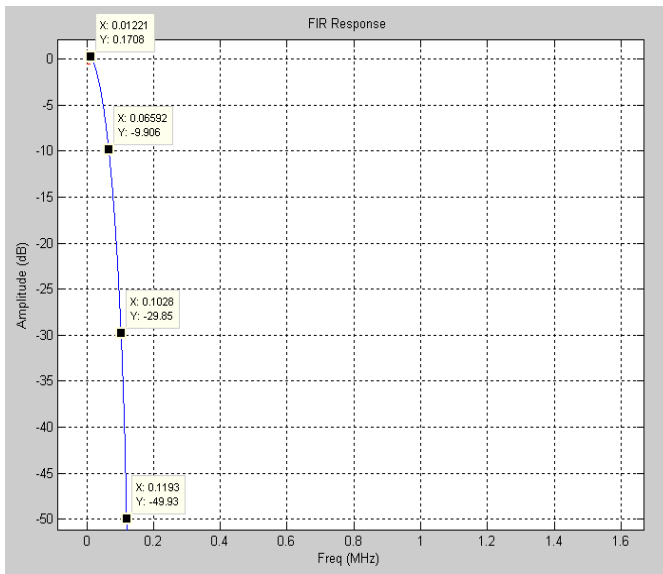


Figure 3. One 25 kHz segment

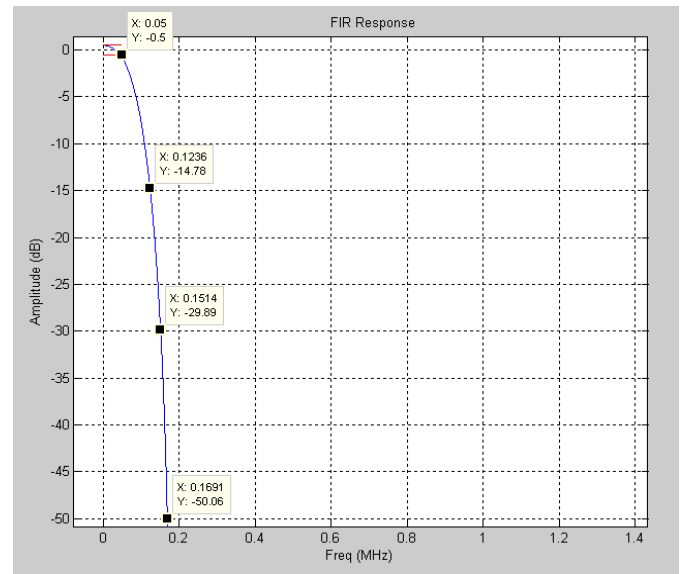


Figure 4. One 100 kHz segment

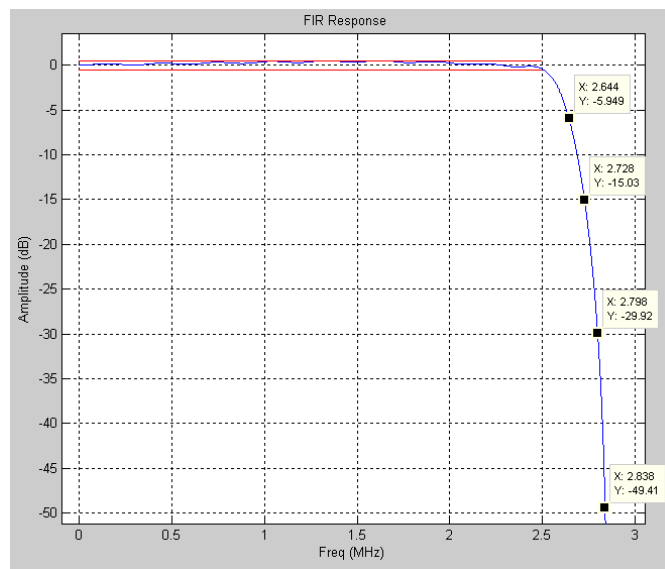


Figure 5. One 5 MHz segment



## **2.4 Hardware AGC**

Hardware automatic gain control (AGC) circuit is intended to prevent undesired oscillations and spurious emissions. The repeater can experience oscillating conditions due to wrong installation factors like small isolation between outdoor donor and indoor coverage antenna isolation. In the case of too high input signal hardware AGC limits the total output power to a value in dBm specified for each model.

Two orange LEDs (DL and UL separately) show the activity of hardware AGC. If they are active, input signal is too high or repeater is oscillating.

In case of higher input signal built-in additional digital step attenuator can be used to decrease gain of the repeater. Also using directional donor antenna or a different faraway BTS could be chosen.

## **2.5 Connectors, indicators, buttons**

SMA connector has a torque 0.5 N/m. N-type connectors have a torque 1.3 N/m. Use appropriate tools when working with these connectors.

For installation convenience control part (LEDs, USB, RESET button) is placed on inside of the CSR-DMT in front position. On bottom side of the CSR-DMT RF connectors, power supply input and other additional connections are placed.

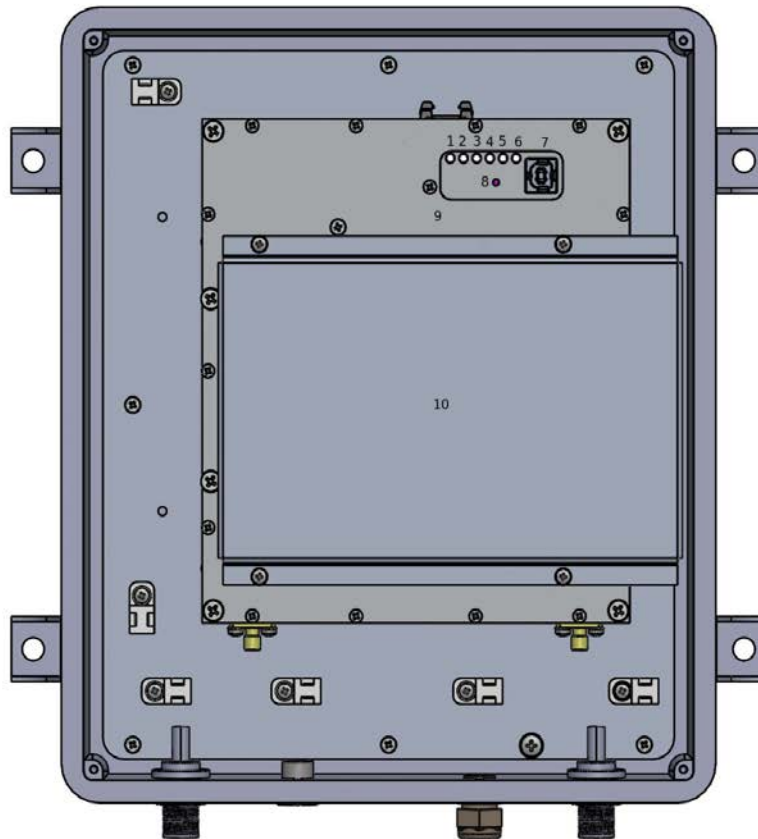
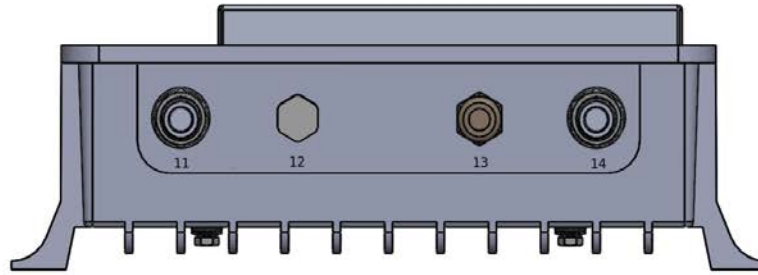


Figure 6. CSR-DMT bottom view and top view

Table 2. Description of connectors, indicators and buttons

Number	Description
1	Reserved LED
2	Orange LED, uplink hardware AGC loop activity indicator
3	Orange LED, downlink hardware AGC loop activity indicator
4	Green LED, MCU activity indicator, proper power supply indicator: - very slow blinking - power down mode - normal blinking - power up mode (normal operation) - fast blinking in case of wrong power supply
5	Red LED, MCU status indicator: busy or free
6	Red LED, error event indicator
7	USB input
8	Reset button
9	Repeater unit
10	Power supply module
11	Indoor antenna connector
12	Pressure valve
13	Power supply 230VAC-input (PG-type)
14	Donor/Outdoor antenna connector

### 3.0 INSTALLATION

#### 3.1 Mechanical installation

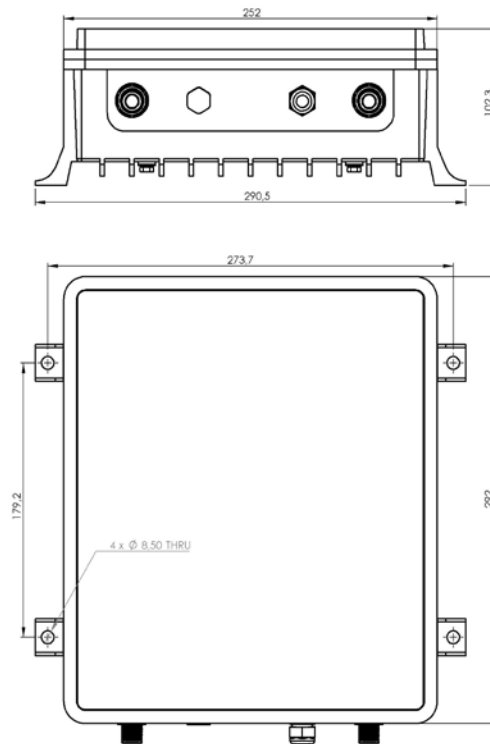


Figure 7. CSR-DMT mechanical dimensions

### 3.2 Electrical installation

**Electrical installation must be performed in accordance with all the local regulations. Electrical installation must be performed by qualified personnel only. Do not open repeater case without required qualification!**

For details about connectors see “2.5 Connectors, indicators, buttons” section of this manual.

1. Connect donor and indoor antennas to corresponding RF ports.
2. Align donor antenna toward desired BTS.
3. If 230VAC cord will be connected right at site, see right electrical clamp types.
4. Check all connections/nodes one more time.
5. Connect 230 V AC cable.
1. In case it is needed, connect USB to CSR-DMT and run PROCOM A/S control software to reconfigure repeater.
6. See activity of AGC LEDs. For details refer to section “2.4 Hardware AGC”.

### 3.4 Driver installation

Microsoft Windows 7 and later already ship with required driver to run Procom control software. In case of Windows XP run ‘CDM v2.12.10 WHQL Certified.exe’ file.

## 4.0 CONTROL SOFTWARE

### 4.1 System requirements

CSR-DMT control software requires a personal computer with:

- At least one USB port and
- Microsoft Windows XP, Vista, 7 or 8 operating system (both 32 bit or 64 bit systems are supported).

### 4.2 Overview

CSR-DMT control software is a GUI tool for repeater configuration. It can be used to set repeater frequency response, adjust gain and monitor health state.

Configuration interface (see section “4.4 Configuration interface” of this manual) is used to:

- set repeater frequency response,
- adjust gain and control software AGC settings,
- store predefined configurations,
- monitor measurements and health state,
- remotely turn repeater on and off.

CSR-DMT repeater can store up to 16 different filter configurations. Each configuration stores not only the filter settings, but also power and software AGC settings. However, there can be only one active configuration.

### 4.3 Establishing a connection

On DR\_Ctrl startup “Select Communication Channel” dialog appears. Select the COM port that is connected to the repeater and press ‘OK’. Program will proceed to load repeater configuration.

## 4.4 Configuration interface

The CSR-DMT repeater has 4 band-segments. Each band-segment (Ch1 – Ch4) can be switched on and off with a check box on the left (Figure 8, 1). Center frequency and bandwidth are changeable. Minimum bandwidth is 25 kHz (one TETRA channel). Maximum bandwidth is 5MHz (full-band mode).

Frequency bandwidth in kHz is displayed in the “Band” boxes (Figure 8, 2) and center frequency in MHz is displayed in “Center Freq Up” boxes (Figure 8, 3) . Cut-off frequencies for up and down links are displayed in “UpLink From/To” (figure 8, 4) and “DownLink From/To” boxes (figure 8, 5).

Enabled bands are allowed to be side-by-side, like (UpLink) Ch2 from 380 MHz to 382 MHz and Ch3 from 382 MHz to 385 MHz, but if bands are overlapping warning message shows and button “Send Config” is disabled. It is impossible to send such configuration to the repeater.

Channel attenuation can be adjusted manually for each channel (figure 8, 6 uplink) and also for all four channels of up (figure 8, 7 uplink) and down links jointly with physical attenuators (see figure 1 “CSR-DMT block diagram” for details). Resulting gain for each channel is displayed in the “Total Gain” boxes for up and down links.

Repeater power could be switched on and off by “Repeater Power” selector individually for each configuration and software AGC (independent from built-in hardware AGC loop) can be enabled or disabled individually for each configuration with “AGC” selector (figure 8, 8).

Repeater name and serial number are displayed in the information boxes below power and AGC settings.

Information box above AGC settings shows configuration state. Values can be “Configuration changed” - meaning repeater has different configuration than shown in DR\_Ctrl; and “Configuration updated” - meaning repeater and DR\_Ctrl configs match.

Repeater health state and measurements are displayed in information blocks “Health State” and “Measurements” (figure 8, 9). User must click on either box to reread the data from repeater. “Health State” boxes are green and “Fault Code” box contains zeroes while repeater is in good health. If there is problem like overheating or power supply voltage is out of range, corresponding boxes will turn red. Measured values of RF power in up and down links, power supply voltage and temperature inside repeater are displayed in the “Measurements” block.

To enable Measurements and Health State automatic refresh check “Autoupdate” check box, buttons become disabled while autoupdate is active to avoid message collision.

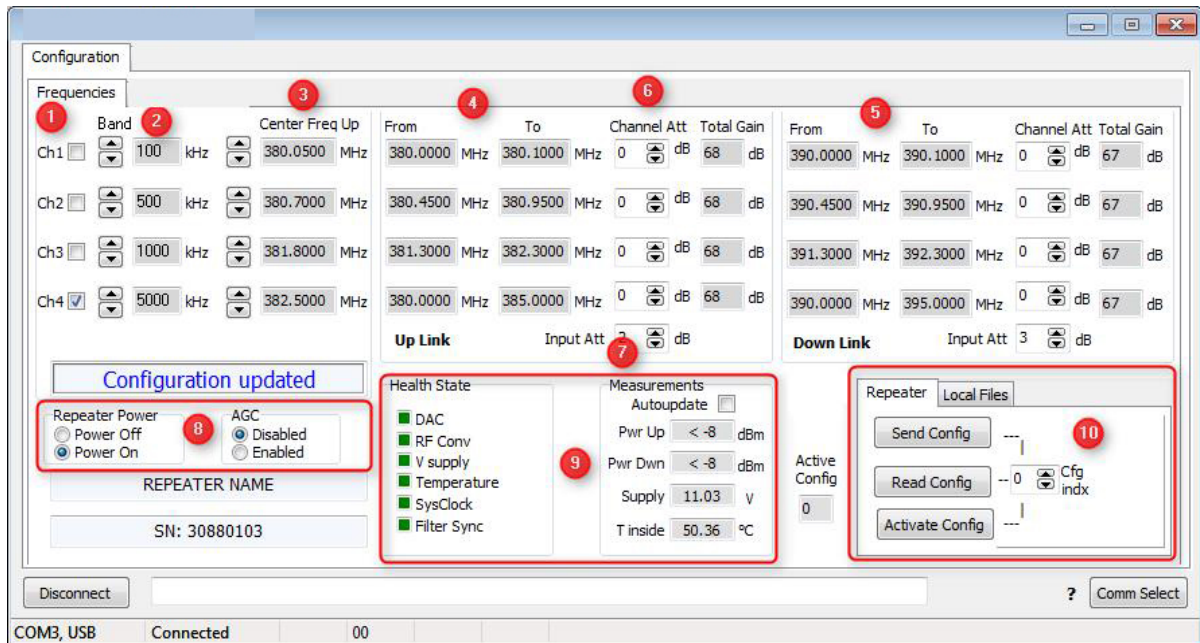


Figure 8  
“Frequencies” tab

Up to 16 different configurations can be stored in repeater. Box “Active Config” shows which one of 16 stored configurations is currently active. “Repeater” tab has configuration index selector “Cfg indx” and buttons “Send Config”, “Read Config”, “Activate Config” (figure 8, 10).

“Read Config” button allows to read configuration selected in “Cfg indx” box. If index selected in “Cfg indx” box is the same as in “Active Config” box then we are dealing with the currently active configuration. “Send Config” button sends configuration visible on “Frequencies” tab to the configuration slot selected in “Cfg indx” box. Pressing “Activate Config” button makes configuration selected in “Cfg indx” box active.

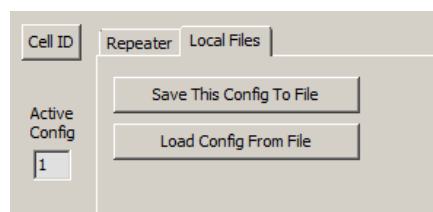


Figure 9. “Local Files” tab

There are two buttons on the “Local Files” tab (see figure 9). “Save This Config To File” button allows to save configuration visible on “Frequencies” tab to a local file. “Load Config From File” button loads such file to the “Frequencies” tab controls. Loaded configuration can be sent to repeater using “Send Config” button.

#### 4.7 Firmware upgrade

CSR-DMT firmware is user upgradeable. Firmware upgrade can be performed locally over a direct USB connection. To perform the upgrade, please contact manufacturer. Manufacturer will supply all the necessary software and up to date instructions.

## 5.0 APPENDIX

### 5.1 Technical specifications

Table 3. Technical specifications

Parameter	Specification
Frequency range*	<b>CSR-DMT-380: Uplink: 380-385 MHz &amp; Downlink: 390-395 MHz</b> <b>CSR-DMT-410: Uplink: 410-415 MHz &amp; Downlink: 420-425 MHz</b>
Number of independent band-segments	Uplink: 1 up to 4 Downlink: 1 up to 4
Band-segment center frequencies	Adjustable through software within specified above frequency range with step 12.5kHz
Bandwidth	<b>Full band mode: 5 MHz</b> Selectivity mode 1: 25 kHz-1MHz with step 25 kHz (adjustable through software) Selectivity mode 2: 1.1-5 MHz with step 100 kHz (adjustable through software)
Max. gain	<b>&gt;70 dB</b> , typ. 75 dB
Full-band flatness	±3 dB, typ. ±2 dB
Manual gain adjust range	50 dB totally: hardware input attenuator 30 dB (step 1 dB) DSP interstage attenuator for each band-segment 20 dB (step 1dB)
Automatic gain control	>60 dB
Downlink output power*	<b>+19 dBm @ one carrier</b> +16 dBm @ two carriers +13 dBm @ four carriers
Uplink output power*	<b>+19 dBm @ one carrier</b> +16 dBm @ two carriers +13 dBm @ four carriers
Noise figure	<b>4.0 dB</b>
Input RF-range	-110...-15 dBm
Supply voltage	AC: 230V, 50Hz
RF inputs	<b>N-Female, 50Ω</b>
Local control interface	USB
Operating temperature range	0 ... +40 °C
Power consumption	27 W (full activity)
Enclosure	IP55 case, 300x291x103mm, mounting on wall (see figures 10, 11)
Absolute maximum RF Input	+15 dBm

\* Ask Procom A/S for other parameters. See [www.amphenolprocom.com](http://www.amphenolprocom.com) for more information.  
Procom A/S reserves the right to change the specification without notice.

## 5.2 CSR-DMT view

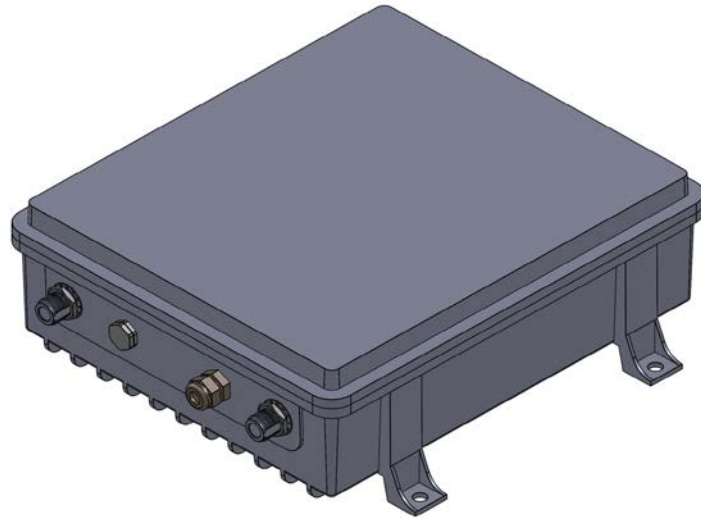


Figure 10. CSR-DMT enclosure (IP55), closed top panel

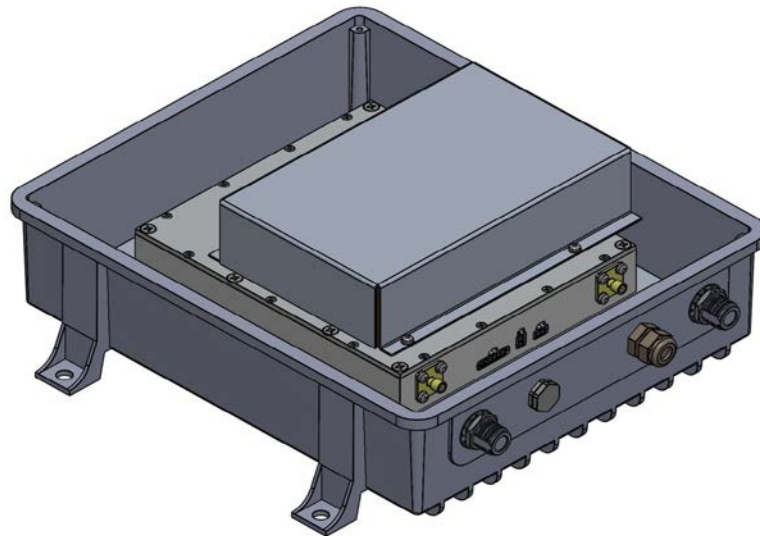


Figure 11. CSR-DMT enclosure, open top panel

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